EIC SIMULATIONS UPDATE

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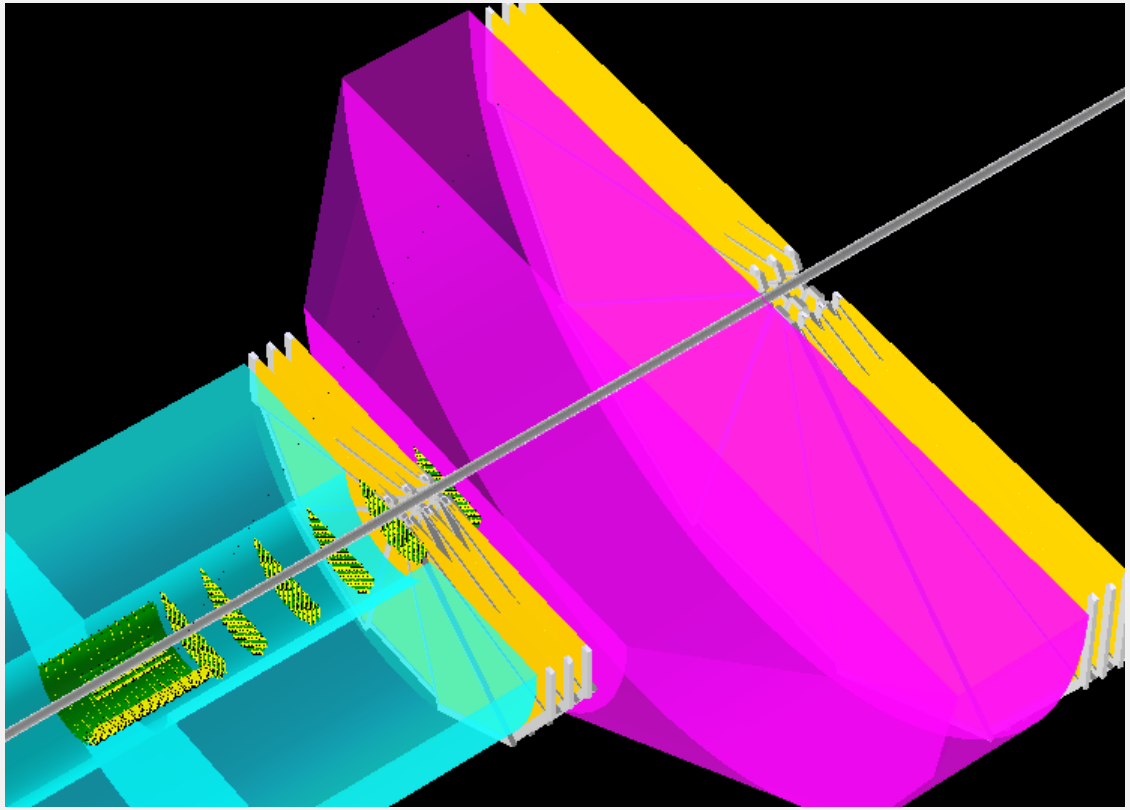
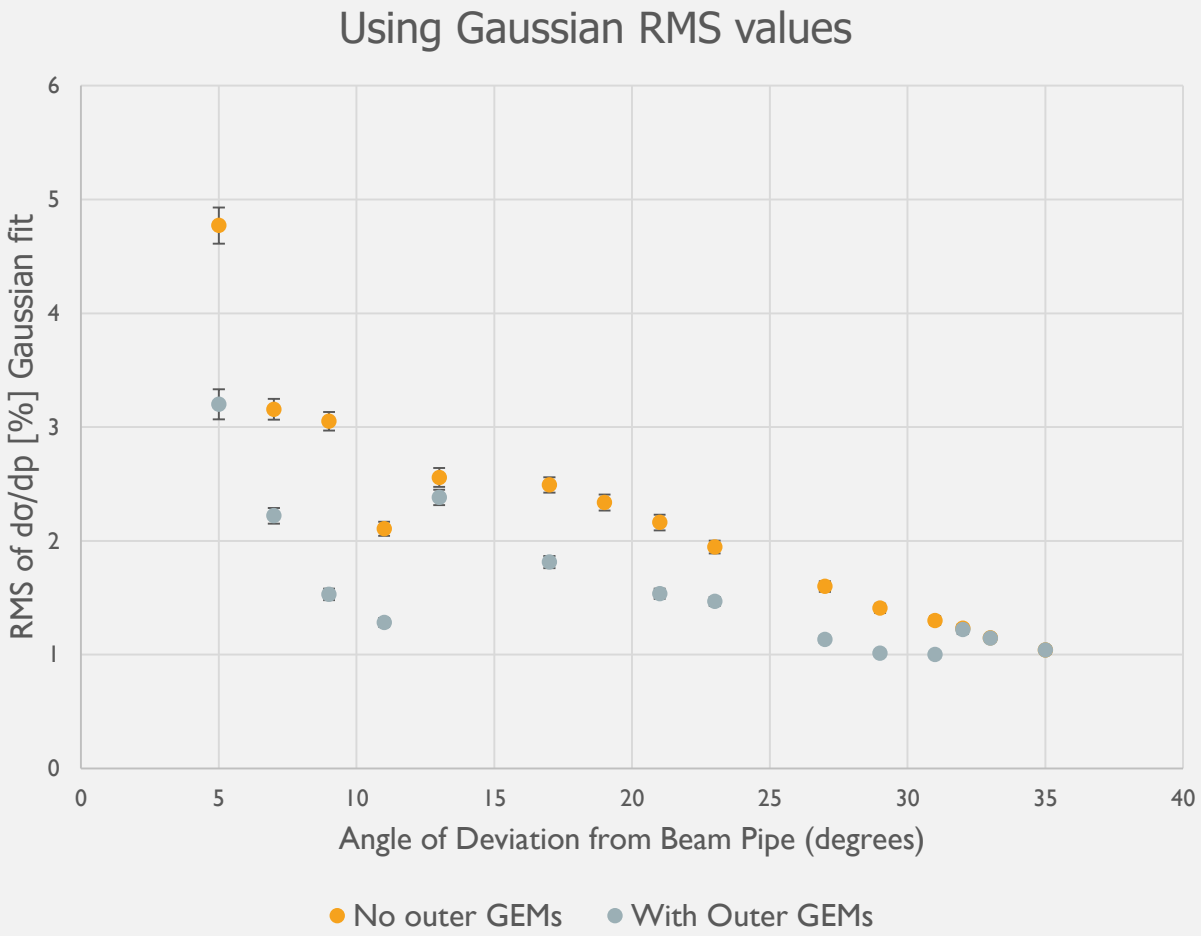
OUTER GEM TEST PARAMETERS

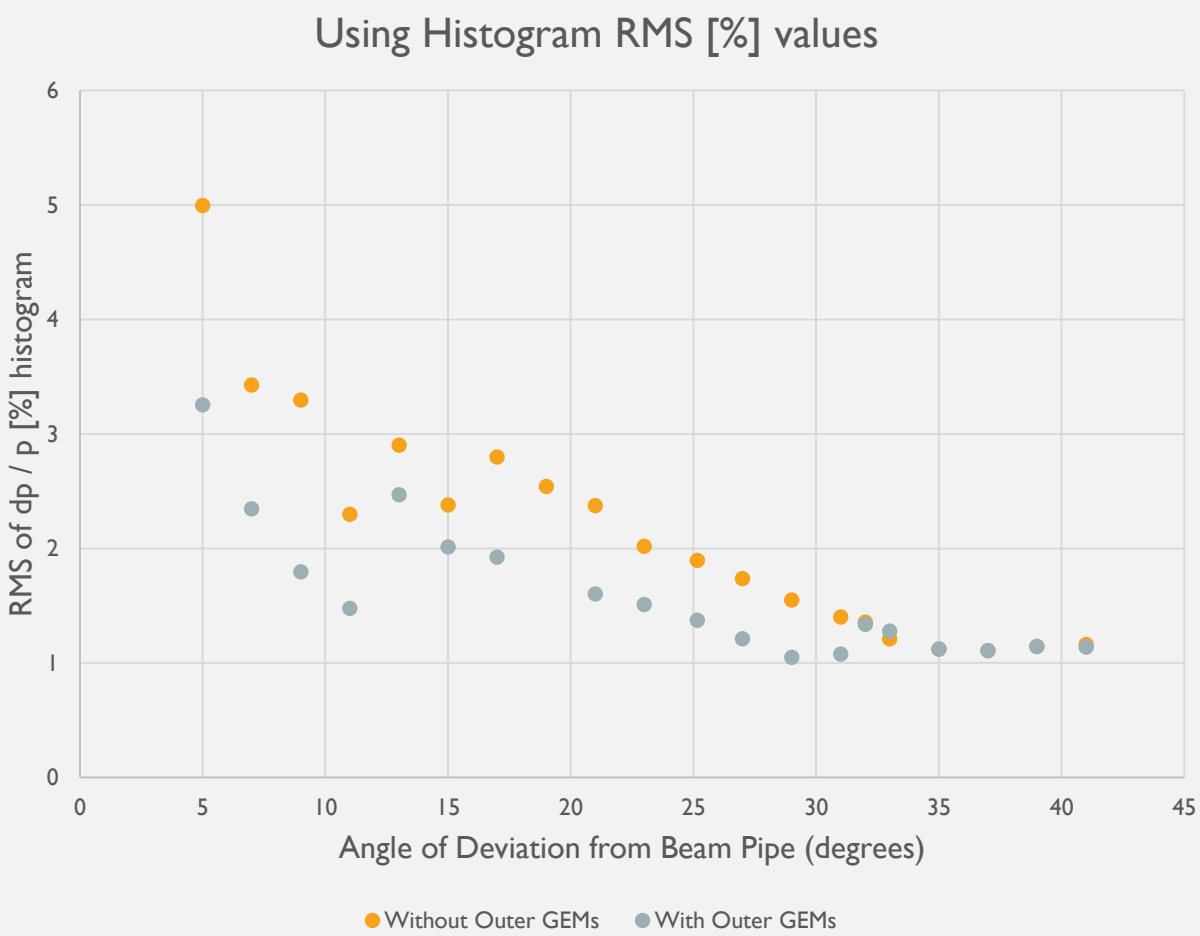


The detector geometry for outer GEM test simulations

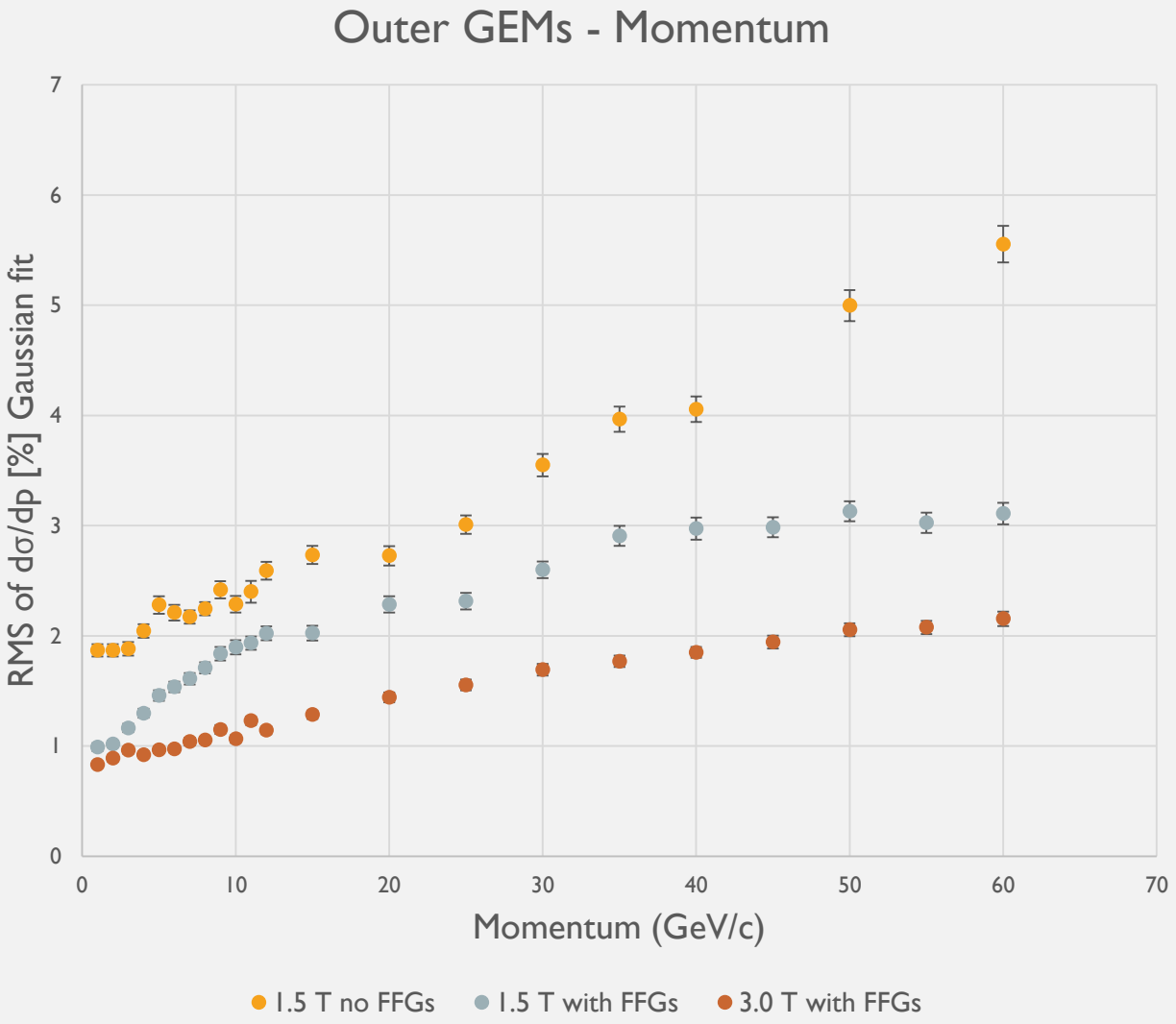
- Now using RMS values from the Gaussian distribution instead of the histogram RMS.
- Error bars obtained from the uncertainty in the RMS values from the χ^2 fit.
- Test parameters unchanged:
  - 1 GeV/c Pions
  - 1000 Simulations per trial
  - Components: VST, FST, Inner GEMs, RICH, Outer GEMs, TPC

OUTER GEM TEST RESULTS



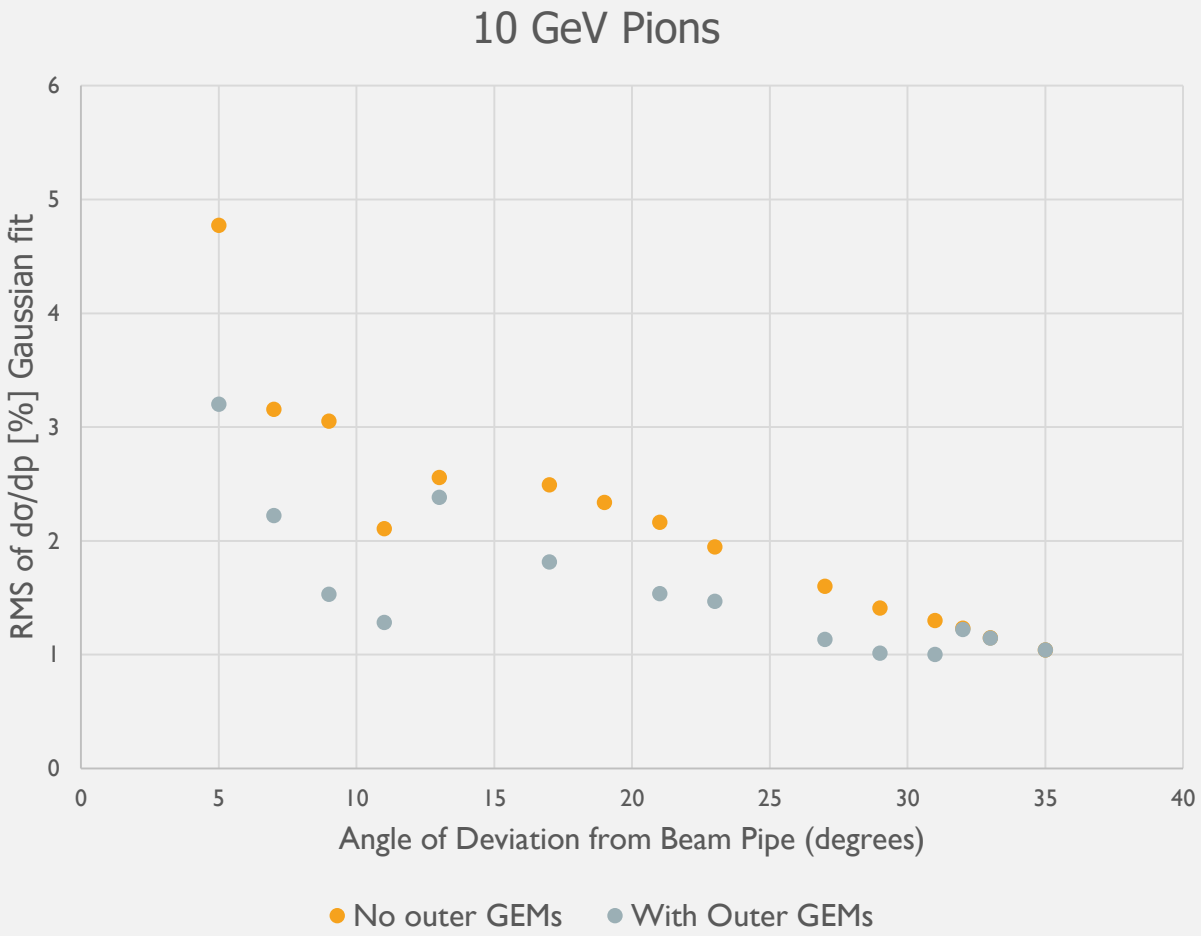


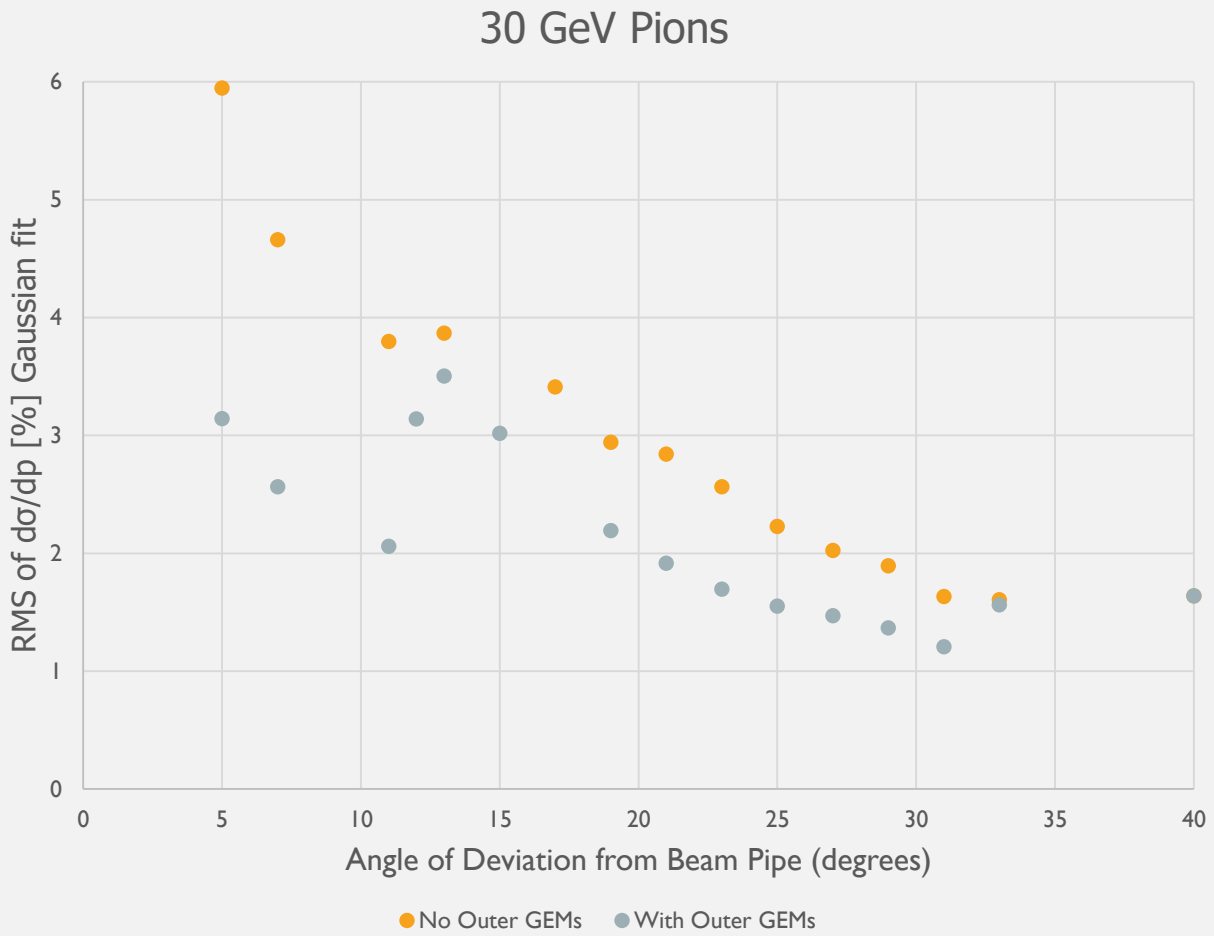
OUTER GEMS – MOMENTUM TEST



- Same simulation parameters as the previous test
- The angle was fixed at theta = 15.41 degrees
- Momentums from 1 GeV/c to 60 GeV/c were tested
- Outer GEMs provide a significant improvement to momentum resolution, especially at the ends of the momentum range
- Note: some data points are missing from 1.5T/no outer GEM trials due to a bug that occurs a certain theta values

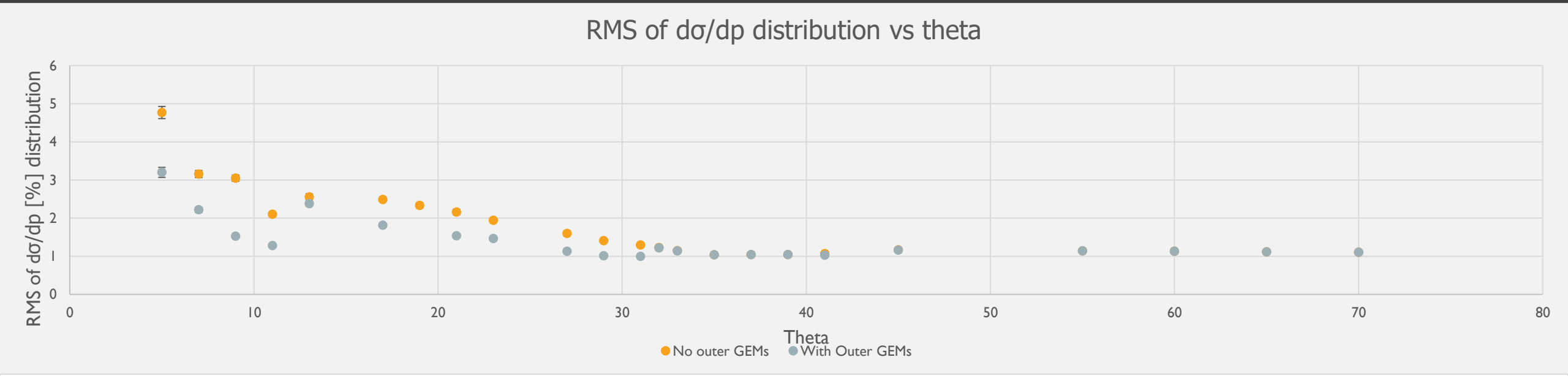
OUTER GEM TEST RESULTS

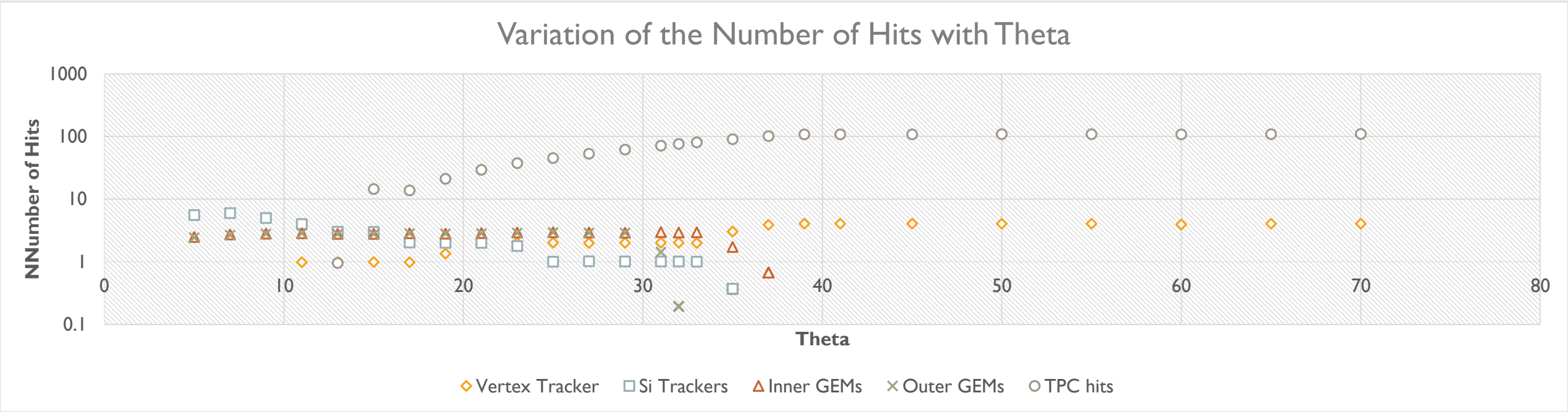




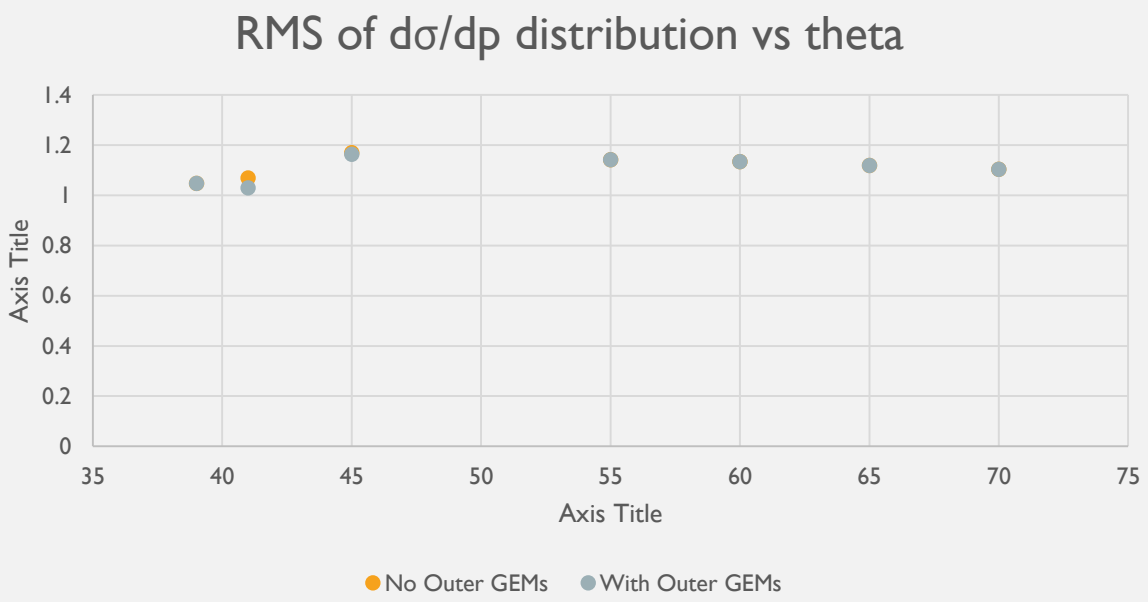
Comparison of the RMS [%] values vs Theta distributions for 10 GeV pions vs the distribution for 30 GeV pions. This shows that the effect of the outer GEMs (shown by the difference in the two curves) is greater for 30 GeV pions.

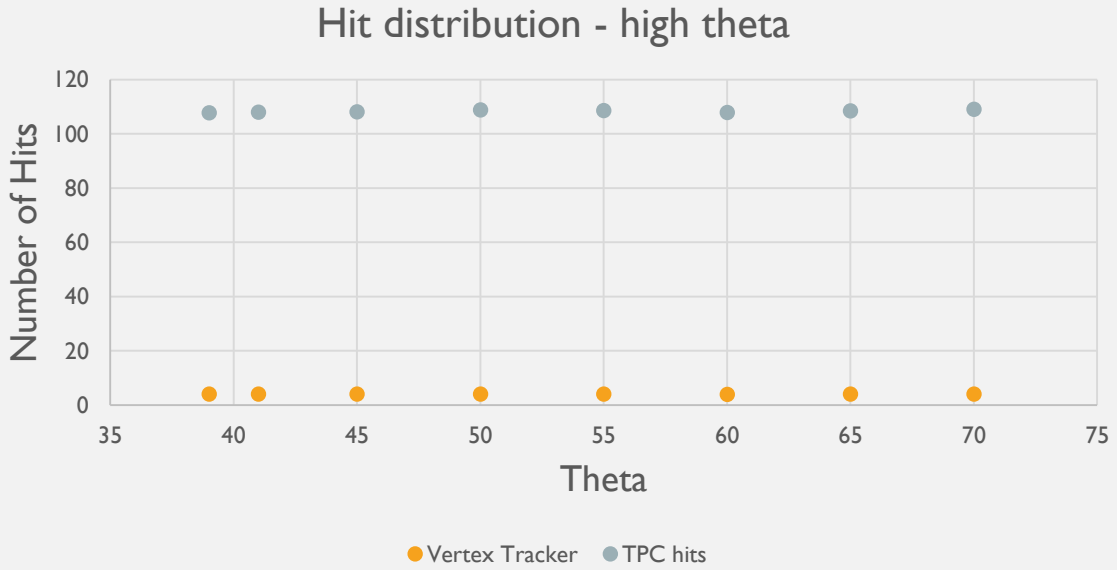
OUTER GEMS – CORRELATION WITH HITS





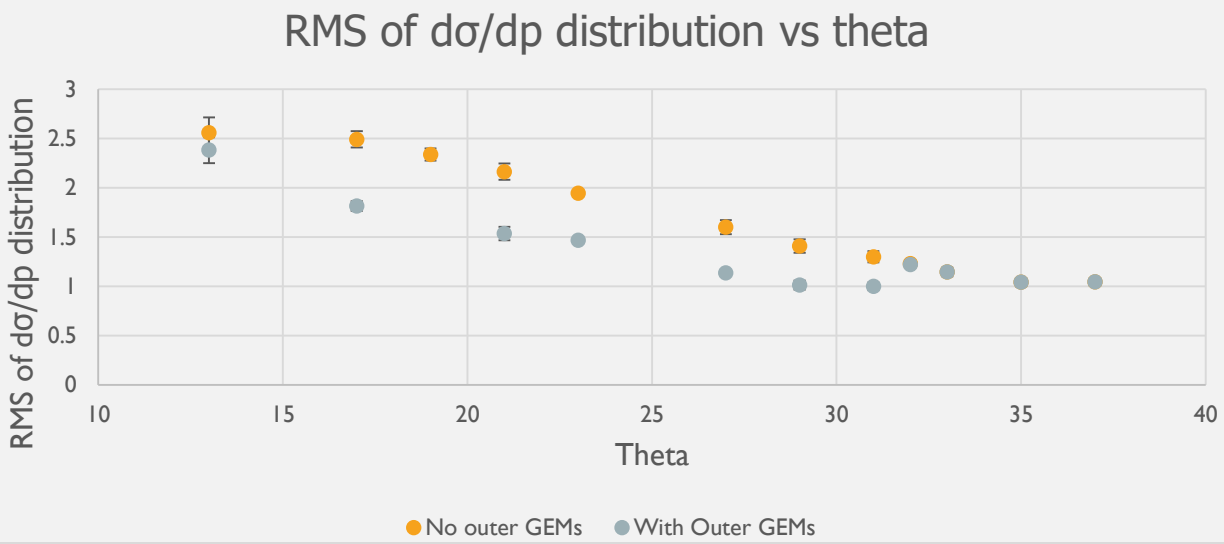
CORRELATIONS AT LARGE ANGLES?



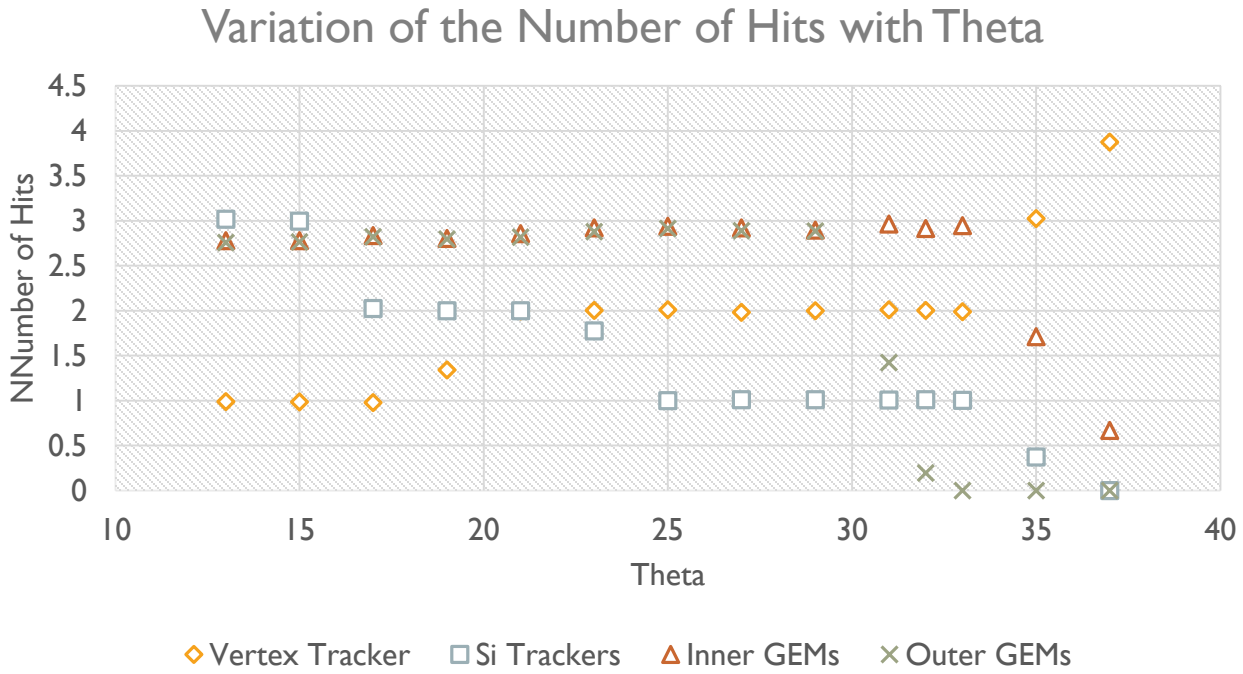


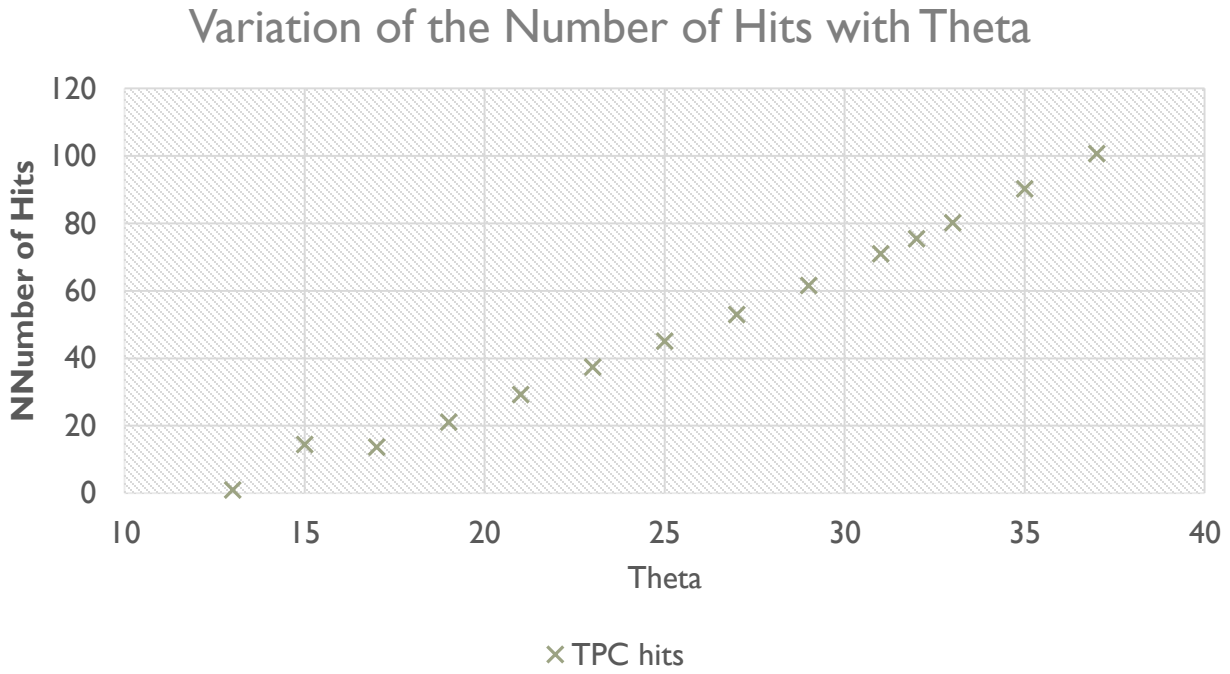
- At large angles (θ > ~39 degrees), only the vertex tracker and the TPC produce hits
- Both hit distributions are roughly linear in this region
- Likewise, the RMS distribution is also roughly linear
- The apparent non-linearity is exaggerated by the small range
- The slight peak at theta = 45 degrees corresponds to a local minimum in the number of hits produced by the vertex tracker

CORRELATIONS AT MID RANGE ANGLES?

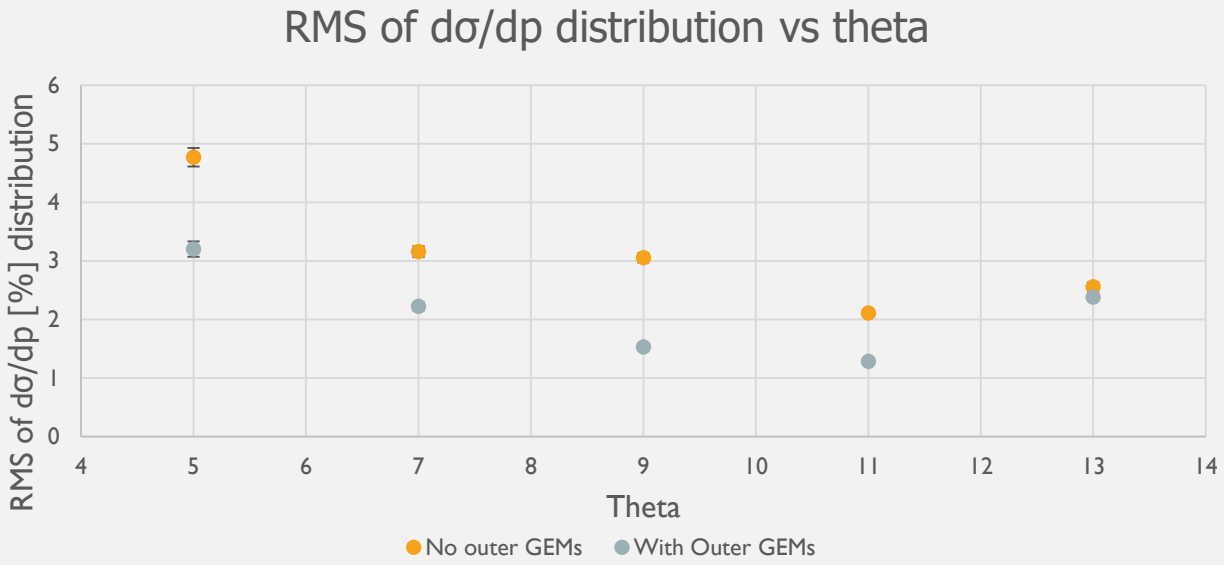


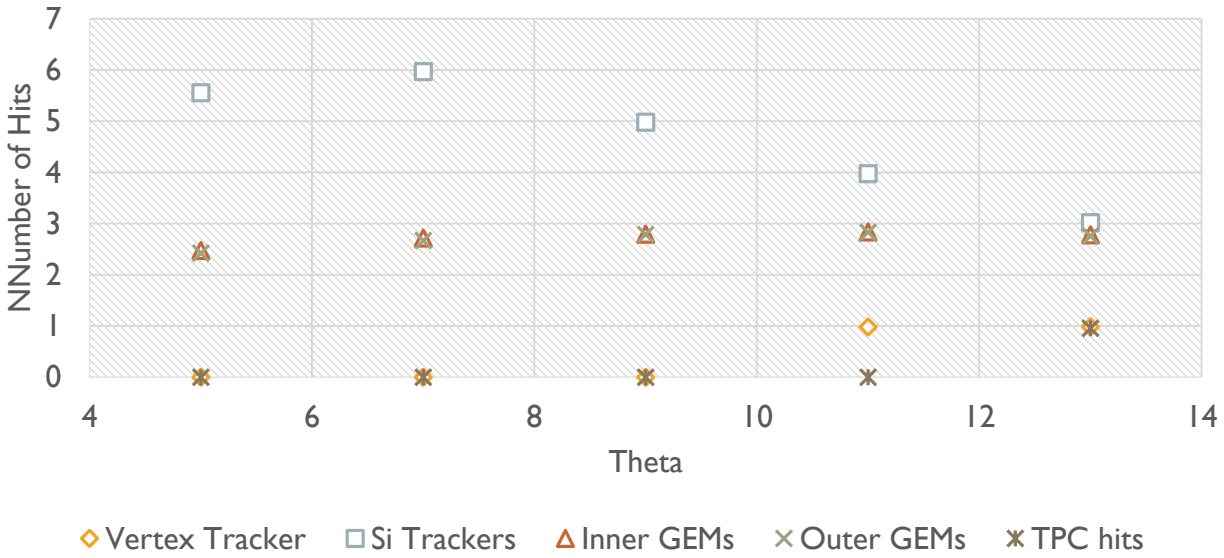
- Overall downward trend due to TPC hits rapidly increasing
- The distributions converge as Outer GEM hits go to zero, as expected





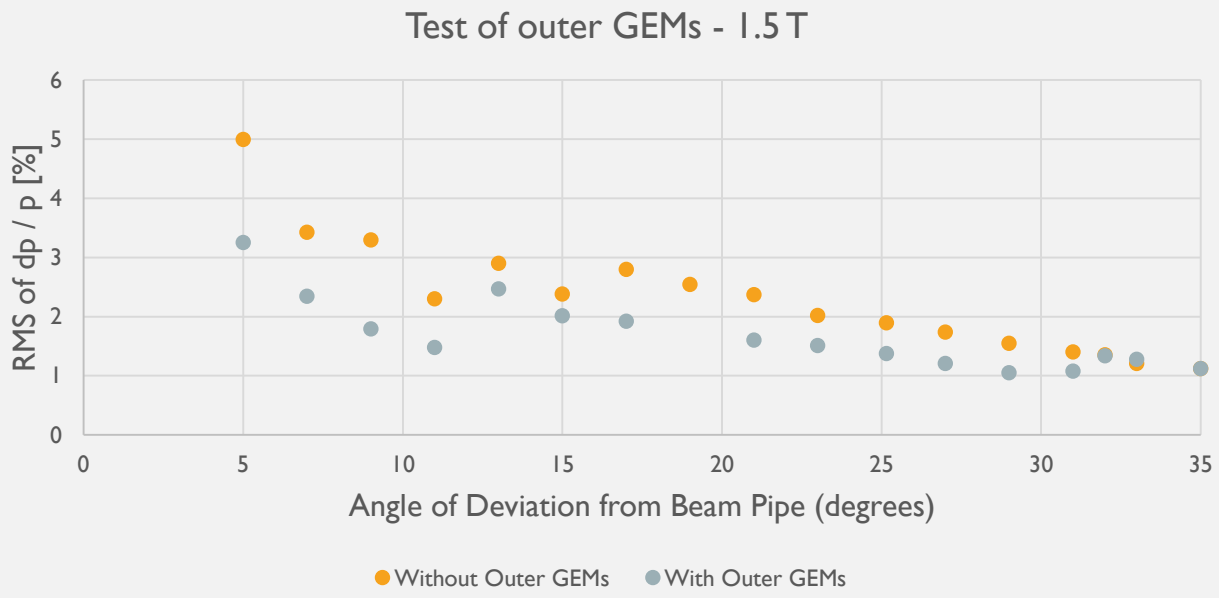
CORRELATIONS AT SMALL ANGLES?

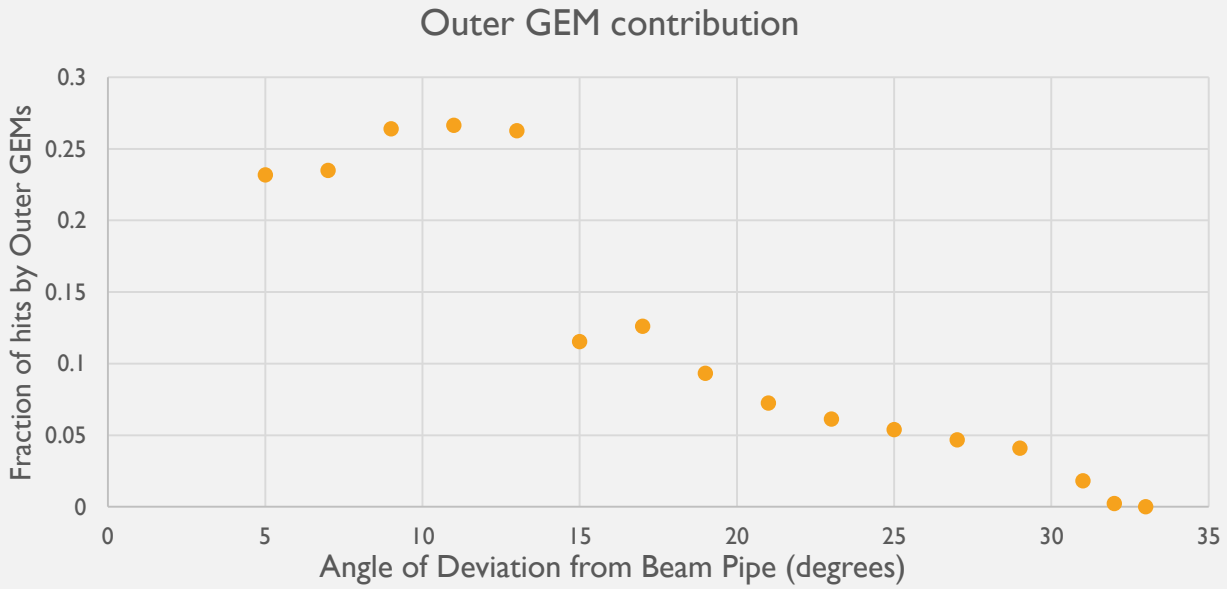




- RMS difference is expected to be a t a maximum when the dependence on the Outer GEMs is at a maximum.
- Difference in RMS values dips at 7 degrees when number of hits by Si tracker hits a local max. Possibly because the relative dependence on the Outer GEMs is smaller when Si tracker produces more hits.
- Difference in RMS values also dips as the vertex tracker begins producing hits (11 degrees), and dips again when TPC begins producing hits (13 degrees). These detectors which are common to both configs also reduce the relative dependence on the outer GEMs.

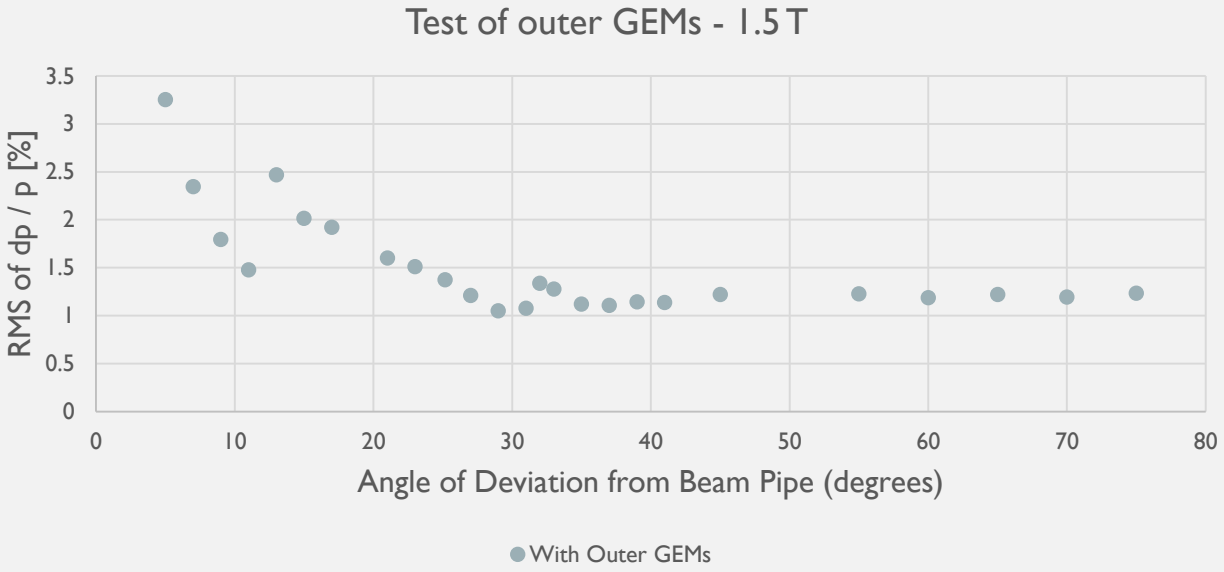
USING FRACTION OF OUTER GEM HITS

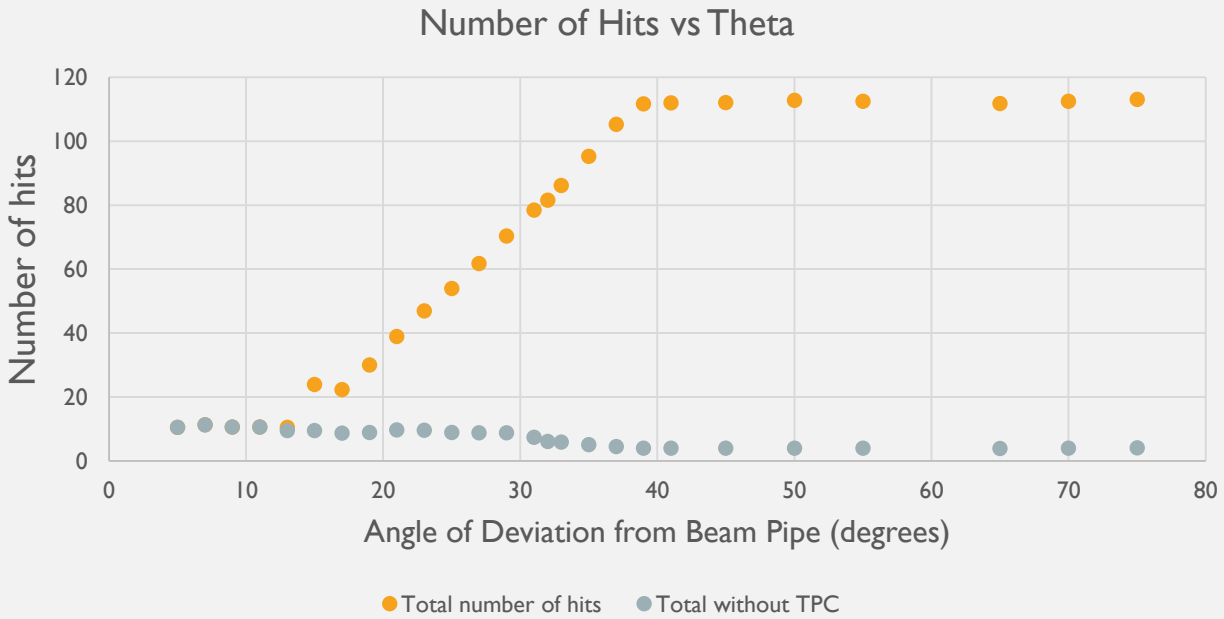




- The lower graph shows the number of Outer GEM hits as a fraction of the total number of hits on all components.
- **<u>If hits on all components are considered to be equal</u>** (i.e., one TPC hit is weighted equally with one Si Tracker hit, or one GEM hit, and so on), then the gap between the distributions on the upper graph should be proportional to the corresponding value on the lower graph.
- There is some supporting evidence, such as large gaps in the upper graph for small theta values, and the distributions in the upper graph converging as the lower distribution goes to zero.
- Some contradictory evidence, such as the upper distributions narrowing as the lower graph hits its maximum.

USING TOTAL NUMBER OF HITS





- The lower graph shows the number of total hits across all detectors (orange), and across all detectors except the TPC (gray). Note that outer GEMs are included in both cases.
- **<u>If hits on all components are considered to be equal</u>** (i.e., one TPC hit is weighted equally with one Si Tracker hit, or one GEM hit, and so on), then the distribution of the upper graph should be roughly proportional to the inverse of the orange distribution of the lower graph.
- There is a large downward trend in the upper distribution corresponding to the region in which the number of TPC hits rapidly increases (13 degrees to 30 degrees).
- After 30 degrees, the number of hits on the outer GEMs, Si Trackers, and Inner GEMs each go to zero in succession (as can be seen on slides 6 and 8, and is visible in the form of dips in the gray distribution), which overpowers the rise in the number of hits on the TPC. This leads to an increase in the RMS despite the rise in the overall number of hits.
- The last point only holds if it is assumed TPC hits are not weighted as highly as other hits.